9 1/2

```
# CELL PROVIDED

# %pip install -q japanize-matplotlib-jlite py4macro
```

```
# CELL PROVIDED

import japanize_matplotlib_jlite
import numpy as np
import matplotlib.pyplot as plt
import py4macro
import random

plt.rcParams['figure.figsize'] = (5, 3.75)
```

μ ( ) (1)

$X_1, X_2 \cdots X_n$ n

$$\overline{X}_n = \frac{X_1 + X_2 + \cdots + X_n}{n} \tag{2}$$

Law of Large Numbers

μ $X_1, X_2, \ldots, X_n$ $\overline{X}_n$ n μ

$$\lim_{n\to\infty} \overline{X}_n = \mu \tag{3}$$

$\mu = 0.5 \times 1 + 0.5 \times 0 = 0.5$

9.2.1

```
random.randint(0,1)
```

1

9.2.2

```
n = 30
toss = [random.randint(0,1) for _ in range(n)]
head = sum(toss)
avr = head / n
avr
```

0.43333333333333335

1:

2:

1 * 1 * 1 1 X_1 * $\overline{X}_1 = X_1$ * 2 * 1 X_2 1 2 * $\overline{X}_2 = (X_1 + X_2)/2$ * 3 * 1 X_3 1 3 * $\overline{X}_3 = (X_1 + X_2 + X_3)/3$ * …… * N * 1 X_N 1 N * $\overline{X}_N = (X_1 + X_2 + \cdots + X_N)/N$

```
N = 2000                    #

sample = range(1, N+1)      # 1 2000
```

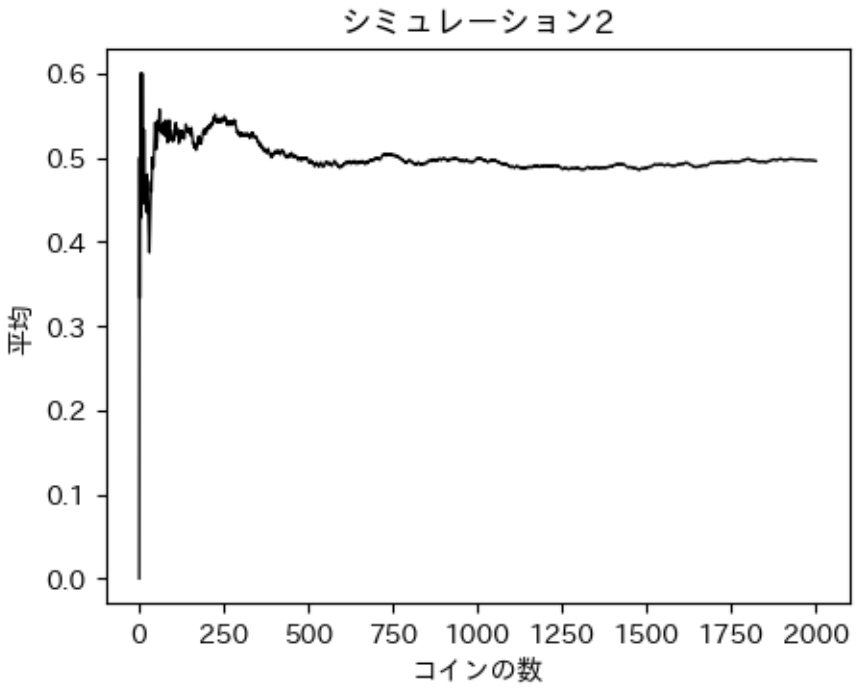
9.2.8

```
random.seed(123)                        #

head_count = 0                          #
avr_lst2 = []                           #

for i in range(1, N+1):                 # 1 2000    for
    coin = random.randint(0, 1)         # i
    head_count = head_count + coin      #  1  0  head_count
    avr = head_count / i                # i
    avr_lst2.append(avr)                #   avr_lst2

plt.plot(sample, avr_lst2,              #   1 2000
         linewidth=0.9,                 #
         color="black")                 #
plt.title("    2",          #
         size=12)                       #
plt.xlabel("   ", size=10)      #
plt.ylabel(" ", size=10)           #
plt.show()
```



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